UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

DEC 20 2013

MEMORANDUM

SUBJECT: **Guidance on Modeling Offsite Deposition of Pesticides via Spray Drift for Ecological and Drinking Water Assessments**

FROM: **Donald J. Brady, Ph.D., Director**
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TO: **All Managers and Staff of the**
Environmental Fate and Effects Division

The attached document provides guidance for estimating spray drift fractions when modeling offsite deposition of pesticides for ecological and drinking water assessments and for estimating distances from the treated field where adverse effects may be observed from exposure to spray drift. Additionally, this guidance provides default assumptions for use by EFED scientists when estimating spray drift in terrestrial and aquatic assessments.

The attached guidance is effective immediately and should be used in risk assessments that have not yet begun development in EFED. If you have any questions regarding this guidance document, please contact Katrina White, Faruque Khan, or Mark Corbin. Earlier versions of this document were reviewed by EFED's former Endangered Species Registration Review Workgroup.

Attachments

Guidance on Modeling Offsite Deposition of Pesticides Via Spray Drift for Ecological and Drinking Water Assessments

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December 19, 2013

ACKNOWLEDGEMENTS

The authors would like to acknowledge the input from two key former EFED workgroups, the Endangered Species Registration Review Workgroup and Litigation Steering Committee. Additionally, this document was reviewed by representatives of other technical teams in EFED, including Kristina Garber, Nicholas Mastrota, Gabe Rothman, Michael Davy, and Greg Orrick.

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1. Purpose of Guidance

During the application of pesticides, an appreciable amount of applied chemical can drift beyond the intended target site to non-target receptors and their habitats or surface water sources. The purpose of this document is to provide guidance on modeling offsite deposition of pesticides through spray drift for ecological and drinking water assessments. Additionally, this guidance provides standard default assumptions for quantifying pesticide deposition from spray drift to terrestrial and aquatic environments and information on the characterization of spray drift buffers used to mitigate identified risks for non-listed species. The Agency is in the process of evaluating its approach for assessing offsite deposition impacts to listed species, given the recommendations outlined in the recent National Academy of Sciences publication "*Assessing Risks to Endangered and Threatened Species from Pesticides*" (NAS, 2013). Once the Agency, the Fish and Wildlife Service, and National Marine Fisheries Service agree on a common approach for the ecological risk assessment process for listed species, this document will be revised accordingly. This document does not provide guidance regarding off-site transport through other mechanisms such as vapor drift, wet and dry deposition, long-range transport, as well as surface water runoff and downstream movement of a compound.

2. Offsite Deposition of Pesticides and Spray Drift Distance

Exposure to spray drift is assessed for agricultural and residential spray applications of liquid formulations, except for applications with hand held or back pack sprayers. EFED does not currently have a method to quantify spray drift from other application methods and materials such as applications of dry materials, drip chemigation, and for applications with hand held or back pack sprayers; therefore, spray drift is assumed to be negligible. AgDRIFT[1] can be used to model spray drift in the following ways:

- Estimate the spray drift fraction for inputs into PRZM/EXAMS for estimating aquatic exposure in drinking water and ecological risk assessments
- Estimate exposure of plants to spray drift in ecological risk assessments
- Estimate the fraction of applied pesticide, used in assessing exposure for terrestrial organisms located off the application site, including for applications directly to water
- Determine the maximum distance from the edge of the area where the pesticide is directly applied (also known as the initial area of concern) to the point where levels of concern (LOCs) are no longer exceeded for both terrestrial and aquatic organisms.

In addition to AgDRIFT, the following models may be needed to estimate spray drift distances for terrestrial and aquatic organisms:

- Terrestrial Residue Exposure model (T-REX)[2]

[1] Spray Drift Task Force Spray Software. AgDRIFT (Version 2.1.1). Available at G:\Models_Repository\AgDRIFT
[2] USEPA 2008. Terrestrial Residue Exposure Model. Available at http://www.epa.gov/oppefed1/models/terrestrial/trex/t_rex_user_guide.htm

- Terrestrial Herpetofaunal Exposure Residue Program Simulation (T-HERPS)[3] to estimate the spray drift distance for terrestrial organisms
- Pesticide Root Zone Model (PRZM)[4] and the Exposure Analysis Modeling System (EXAMS)[5]

Spray drift distances are distances from the edge of the field where LOCs may be exceeded and they are important in determining possible options for mitigating risk. For screening level assessments, spray drift analysis should be limited to the Tier I module in AgDRIFT unless the label specifies certain application parameters to limit spray drift potential. For example, use of a helicopter or applications at wind speeds of 15 mph would require use of Tier II or III modeling in AgDRIFT. Tier II and III modules are only available for aerial applications. Tier II and III modules allow the user to modify many variables pertinent to spray drift to make the scenario more representative.[6] In general, Tier II and III modules are used for refining geographic extent of risk and mitigating risk. The assessor may consider using both the Tier II and III modules in AgDRIFT on a case-by-case basis. The maximum spray drift distance using Tier I and II analyses is 997 feet and the maximum spray drift distance using Tier III analysis is 2608 feet. Aquatic and terrestrial assessment results for Tier II and III analyses are similar to the results from Tier I analysis with the ASAE (American Society of Agricultural Engineers)[7] Very Fine to Fine drop size distribution (DSD) across a range of target deposition values (Appendix A). Tier II and III analyses will require justification when using input parameters that deviate from the default parameters. The AgDRIFT module for modeling multiple applications should not be used.[8] Consult the Fate Tech Team and Water Quality Tech Team for guidance on modeling ultra low volume (ULV) applications[9].

2.1. *Initial Inputs/Setup for AgDRIFT for Terrestrial and Aquatic Assessments*

- Open AgDRIFT and choose the appropriate Tier for your assessment.
- Unless parameters are specified on the label, select the appropriate default input parameters

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[3] USEPA 2008. Terrestrial Herpetofaunal Exposure Residue Program Simulation. Available at http://www.epa.gov/oppefed1/models/terrestrial/therps/t_herps_user_guide.htm

[4] USEPA 2006. Pesticide Root Zone Model. Available at http://www.epa.gov/oppefed1/models/water/#przm

[5] USEPA 2005. Exposure Analysis Modeling System. Available at http://www.epa.gov/ceampubl/swater/exams/index.html

[6] Tier II allows the user to modify drop size distribution (DSD), nonvolatile application rate, active application rate, spray application rate, carrier type (water or oil), wind speed, temperature, relative humidity, aircraft type, boom length, boom height, number of swaths, swath width, and swath displacement. The Tier III module allows the user to access all model inputs including the Spray Drift Task Force (SDTF) spray materials evaporation library, wind direction, the SDTF aircraft library, nozzle positioning, surface roughness, and access to the Spray Block Statistics calculator for inferring swath width, Coefficient of Variation (COV), and mean deposition within the spray block for input conditions specified to the model.

[7] ASAE has been replaced by the American Society of Agricultural and Biological Engineers (ASABE); however, AgDRIFT is still using the ASAE abbreviation. In the future, labels may list ASABE standards rather than ASAE.

[8] Note that PRZM/EXAMs will assume spray drift with each application, and multiple applications are also considered in T-REX to arrive at the target fraction of applied. So while EFED does not use this module, exposure to multiple spray drift events is considered in the risk assessment.

[9] An ultra low volume application is a method of dispensing liquid pesticides at the rate of one half gallon or less per acre.

as shown below.

Agricultural, Golf Courses, and Residential Scenarios

a. Tier I Ground Applications: high boom height[10], ASAE Very Fine to Fine Drop Size Distribution (DSD), a 90th percentile data percentile, do not access extended settings
b. Tier I Aerial Application: use ASAE Fine to Medium DSD[11]
c. Tier I Orchard/Airblast: Sparse (Young/Dormant)[12]: do not access extended settings

- Click on Toolbox and choose aquatic assessment for the aquatic environment or terrestrial assessment for the terrestrial environment.

Current default assumptions for aerial applications in AgDRIFT include the following:
- a wind speed of 10 mph,
- 60-foot swath width,
- release height of 10 feet,
- boom length: 76.3%, and
- swath displacement definition: fraction of swath width 0.3702.

If the label specifies that aerial application parameters beyond Tier I may occur (*e.g.*, higher wind speeds or release heights), use Tier II or Tier III, whichever is applicable. If these best management practices are not followed and are not on the label, spray drift may be greater than that predicted using default input parameters and Tier I analysis. This information should be included in the risk assessment. If the evidence indicates that applications will likely not be consistent with the default assumptions (for example, the ASAE Fine to Medium DSD), the expected application parameters should be modeled in AgDRIFT.

Generally, any changes made to these initial input parameters should be based on enforceable statements on labels. When a buffer distance is specified on a label, the number is placed in the "Distance to Water Body from Edge of Field" in the AgDRIFT aquatic or terrestrial assessment screen to estimate the spray drift fraction for inputs into PRZM/EXAMS or inputs into T-REX if assessing risk off the field (*e.g.*, for an aquatic application). If different labels have different use restrictions, ensure that the input parameter(s) modeled is the most conservative (*e.g.*, results in the highest percentage of spray drift or longest spray drift distance) or show the range that is representative of all labeled directions.

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[10] In AgDRIFT, a low boom is 0.508 m or 20 inches in height and a high boom is 1.27 m or 50 inches in height. The assumed swath width is 45 ft.

[11] The Very Fine to Fine DSD results in higher spray drift deposition than the ASAE Fine to Medium DSD assumption. If evidence is available indicating that the Very Fine to Fine DSD is likely to be used and it is allowed on the label, this DSD may be modeled instead of the ASAE Fine to Medium DSD.

[12] The orchard/airblast provides an estimate of the 50th percentile of drift. The empirical data supporting the development of airblast exposure was very limited, and a 90th percentile estimate is not available at this time. Therefore, the orchard airblast exposure estimate is not an upper bound exposure estimate. Use of other orchard/airblast modules should be used carefully since the current estimate of exposure may not be conservative. EFED plans on developing a methodology to provide a conservative exposure estimate for airblast uses in the future.

2.2. *Modeling Exposure to Terrestrial Organisms Off the Field*

2.2.a Estimating Exposure off the Field

T-REX estimates exposures to terrestrial animals from residues on potential food items found at the site of application (*i.e.*, on the field). For determining potential risk to terrestrial animals from dietary exposure off the site of application (*e.g.*, including for applications made directly to water), T-REX can be used in conjunction with spray drift models (*e.g.*, AgDRIFT). For terrestrial animals, under Terrestrial Assessment in AgDRIFT, select Point Deposition and input the buffer distance specified on the label under "Distance To Point or Area From Edge of Field." The "Fraction of Applied" for ground and aerial applications will give you the fraction of the application rate that organisms will be exposed to at the specified distance. Multiply the application rate by the Fraction of Applied for aerial and ground applications and use the product of the two as the input for the application rate in T-REX. For applications directly to water, T-REX will be used to assess risk to terrestrial animals based on the conservative assumption that exposure at the edge of the field will be identical to exposure on the water body. For bare ground applications, use T-REX to estimate exposure on the field and explain that the EECs for seeds and insects reflect exposure on the field and exposure to residues on plants, which will mainly occur at the edge of the field.

TerrPlant[13] estimates exposure to plants adjacent to the site of application. The next section discusses how to estimate a distance from the edge of the field where terrestrial plants may be exposed to spray drift at levels that could result in a Level of Concern (LOC) exceedance (*e.g.*, a spray drift distance).

2.2.b Estimating the Terrestrial Spray Drift Distance

Below are instructions for calculating a spray drift distance or the distance from the edge of the field where LOCs may be exceeded for terrestrial organisms. All spray drift distances should be rounded to a whole number.

Terrestrial Animals: Calculate the target[14] "Fraction of Applied"[15] for terrestrial animals based on risk quotients that are generated using T-REX or T-HERPS, acute and chronic terrestrial animal endpoints, and the appropriate LOCs. Risk quotients should be calculated using the maximum application rate and the maximum number of applications.[16] For sublethal effects endpoints, the LOC is not established for acute sublethal effects and is assumed to be one in the

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[13] USEPA 2009. TerrPlant. Available at http://www.epa.gov/oppefed1/models/terrestrial/

[14] The target refers to that "fraction of applied" that will result in RQs being below LOCs.

[15] $$\text{Aerial and Ground Applications Target Fraction of Applied} = \frac{\text{Level of Concern}}{\text{Risk Quotient}}$$

$$\text{Airblast Applications Target Fraction of Applied} = \frac{\text{Level of Concern}}{\text{Risk Quotient}} \times 0.5$$

[16] While conceptually this calculation results in combining an RQ based on multiple applications in T-REX with a single exposure event for spray drift, the resulting spray drift distance will mitigate risk for both a single application and multiple applications. See Appendix D for validation of this approach.

calculation of the target Fraction of Applied as specified in Footnote 15.[17] Under Terrestrial Assessment, select Point Deposition and input the target Fraction of Applied. Click on "Calc." Figure 1 shows an example calculation. Inputs are "Point Deposition" and the "Fraction of Applied." The output is the "Distance to Point or Area Average from Edge of Field," and it represents the terrestrial spray drift distance. In Figure 1, the spray drift distance is 26 feet.

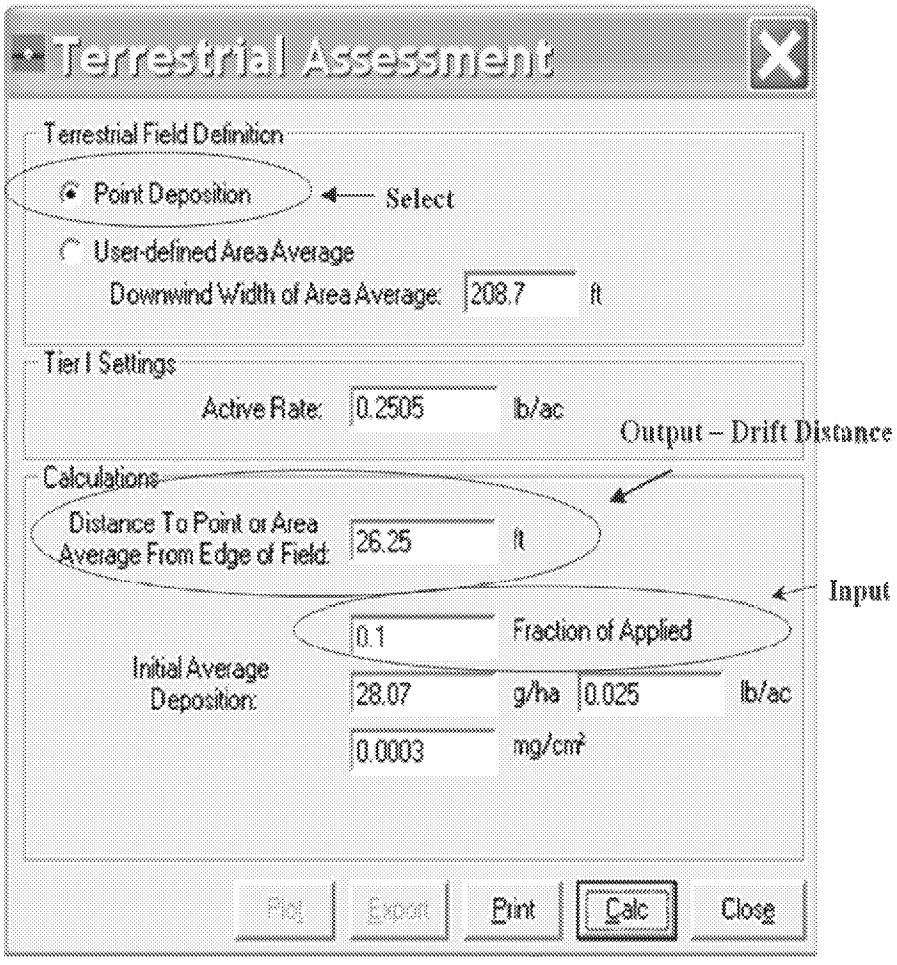

Figure 1. Example calculation of the terrestrial spray drift distance using the target "Fraction of Applied" as the input for a ground application. The inputs are "Point Deposition" and the "Fraction of Applied." The output is the "Distance to Point or Area Average from Edge of Field," and it represents the terrestrial spray drift distance. In this calculation, the spray drift distance is 26 feet.

Terrestrial Plants: Under Terrestrial Assessment, select "Point Deposition," input the maximum single application rate in pounds active ingredient per acre into the "Active Rate" and the appropriate toxicity endpoint into "lb/ac" under "Initial Average Deposition" for ground and aerial applications and click on "Calc." Figure 2 is a screenshot from AgDRIFT using this method. This assessment does not consider spray drift deposition from multiple applications.

[17] This calculation applies to sublethal effects that do not have a corresponding LOC, such as acute sublethal effects. There are some chronic growth and reproductive endpoints for which the chronic LOC of one is commonly used.

The EC_{25} values for the most sensitive tested monocot and dicot species from either seedling emergence or vegetative vigor tests are used to define the toxicity of the pesticide for non-listed species.

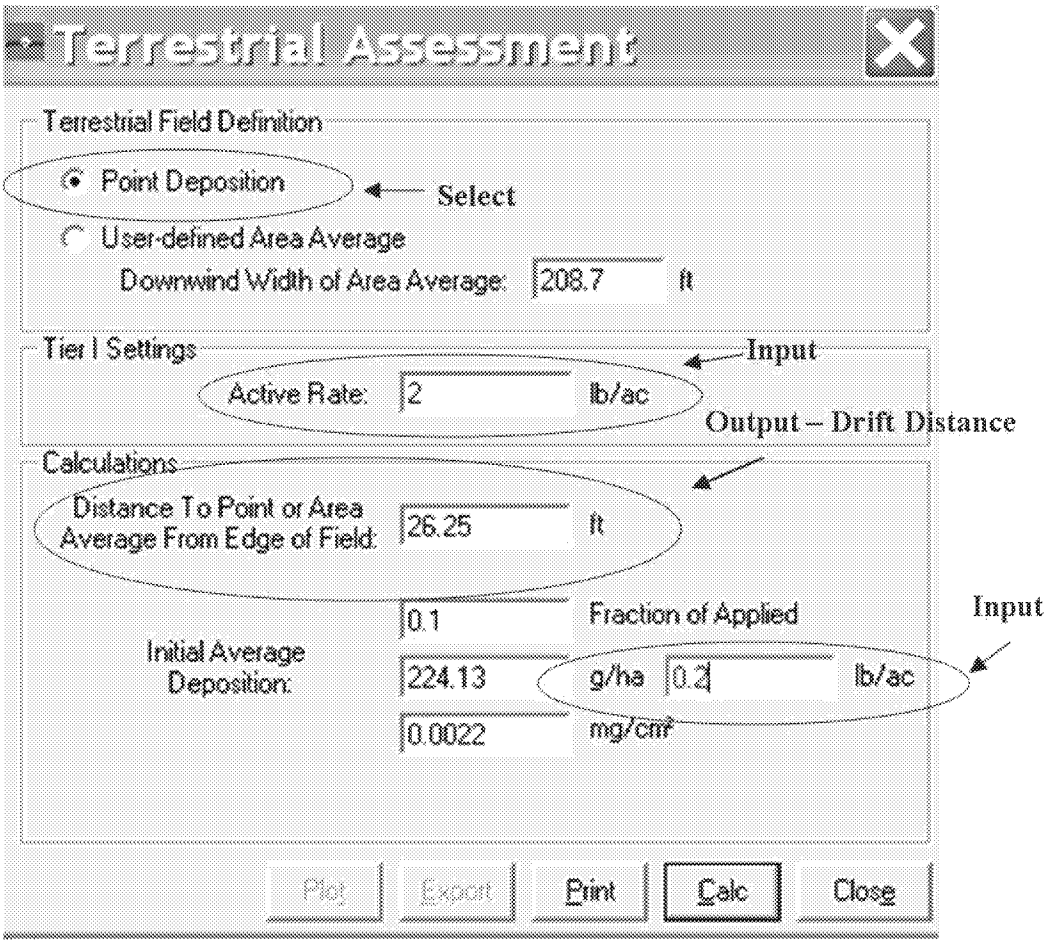

Figure 2. Example calculation of the terrestrial spray drift distance using the "Active Rate" and "Initial Average Deposition" in "lb/ac" as the input. The output is the "Distance to Point or Area Average from Edge of Field," and it represents the terrestrial spray drift distance. In this calculation, the spray drift distance is 26 feet.

2.3. *Modeling Exposure to Aquatic Organisms Off the Field*

Aquatic model scenarios run without spray drift represent aquatic concentrations due to runoff only, *e.g.*, assuming no drift due to spray drift buffer setback. Comparing concentrations with and without drift gives an estimate of the contribution of drift to aquatic concentrations and information on whether a buffer may be used to mitigate risk to aquatic organisms. The relative importance of runoff and drift in PRZM/EXAMS scenarios is dependent on application parameters, the climatic conditions of the scenario and the timing of application. Table 1 provides an example of the percentage of the exposure estimates due to spray drift for one chemical for a set of California sites. Runoff accounted for a wide range of the total estimated environmental concentrations (EEC). For example, runoff accounted for a high percentage of

the EEC in the forestry and nursery scenarios (71 – 98%) and a very low percentage of the EEC for the fruit and melon scenarios (2 –12%).

Table 1. Estimated amount of the EEC that is due to runoff (the higher the percentage the less the EEC was influenced by spray drift)*

Scenario	Runoff-only (EECs) /Runoff plus Drift EECs (Percent)		
	Peak	21 Day	60 Day
CAnurserySTD	98%	90%	85%
CAColeCropRLF	81%	52%	44%
CAcotton_WirrigSTD	66%	38%	32%
CAtomato_WirrigSTD	30%	11%	9%
CA almond WirrigSTD	26%	17%	20%
CAfruit_WirrigSTD	12%	6%	5%
CAMelonsRLF	6%	3%	2%

*All model runs involved the same compound and same input parameters, except for spray drift. When drift was included in the scenario, the drift fraction was assumed to be 0.01 or 0.05, depending on whether an aerial or ground application was modeled. These percentages would be different if these default values were not used.

One important caveat for this analysis is that the spray drift analysis should also include an evaluation of the most sensitive toxicological endpoint. Even for scenarios where runoff contributes substantially to an EEC, a highly sensitive taxa with a low toxicity endpoint (*e.g.*, having a high toxicity) could yield a large spray drift buffer for mitigating exposure to spray drift. The aquatic spray drift distance could result in a greater spray drift distance than the terrestrial spray drift distance. Therefore, if LOCs are exceeded, a spray drift distance may be calculated regardless of whether runoff or spray drift are driving aquatic EECs.

In general, buffers that are vegetated and well maintained to prevent channelized flow have been shown to be best for reducing pesticide loading. The document titled "*Conservation Buffers to Reduce Pesticide Losses*" describes how to maintain buffers in a manner to prevent concentrated flow and to maximize pesticide trapping (USDA, 2000). The Agency does not currently have an approved tool to model the impact of various buffer distances and types on runoff loading. If channelized flow occurs in buffers, pesticide loadings in runoff to a water body can be significant. Additionally, many agricultural areas and golf courses have installed drainage that flows directly into water bodies (Wright and Sands 2001; Haith and Rossi 2003).

2.3.a Estimating the Aquatic Spray Drift Fraction for Use in PRZM/EXAMS at a Specified Distance from the Edge of the Field

When estimating aquatic exposure using PRZM/EXAMS, estimate the spray drift fraction using AgDRIFT, starting with deposition at zero feet from the edge of the field. For ecological risk assessments, the "EPA Defined Pond" is used as the water body in AgDRIFT. Appendix B provides instructions for estimating the spray drift fraction using AgDRIFT and provides tables of the spray drift fraction for different distances for the "EPA Defined Pond," which is used to

estimate aquatic exposure in ecological risk assessments. For drinking water assessments, the spray drift fraction is calculated as specified in Appendix C.[18] The Application Efficiency is 0.95 for all aerial applications and 0.99 for all ground applications, including orchard airblast applications, regardless of the spray drift fraction.[19] For granular applications and other applications methods, EFED assumes negligible drift; therefore, the spray drift and application efficiency should be set to 0.00 and 1.0, respectively. Table 2 provides example spray drift inputs at zero feet from the edge of the field using AgDRIFT Tier I default assumptions. All other input parameters should follow the *Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides*[20].

Table 2. PRZM/EXAMS Default and Additional Inputs for Percent of Spray Drift for Applications of Liquids without Any Spray Drift Limitations (Estimated Using AgDRIFT Version 2.1.1)

Type of Application	Drop Size Distribution (DSD)	Percent of Spray Drift for Runoff and Drift EEC without Buffer[d]
Ecological Risk Assessment Using EPA Farm Pond		
Aerial	Very Fine to Fine	24.2
	Fine to Medium (default)[c]	**12.5**
	Medium to Coarse	8.9
	Coarse to Very Coarse	6.8
Ground (High boom)[1]	**Very Fine to Fine (default)[c]**	**6.2**
Ground (Low boom) [1]	Very Fine to Fine	2.7
Ground (High boom) [1]	Fine to Medium/Coarse	1.7
Ground (Low boom) [1]	Fine to Medium/Coarse	1.1
Airblast (Sparse: young , dormant)	**Aerosol to Very Fine[c]**	**4.2[a]**
Airblast (Dense)	Aerosol to Very Fine	1.5[b]
Airblast (Vineyard)	Aerosol to Very Fine	0.2[b]
Airblast (Orchard)	Aerosol to Very Fine	2.2[b]
Drinking Water Assessments Using Index Reservoir[b]		
Aerial	Very Fine to Fine	25.8
	Fine to Medium (default)[c]	**13.5**
	Medium to Coarse	9.7
	Coarse to Very Coarse	7.6
Ground (High boom)	**Very Fine to Fine (default)[c]**	**6.6**
Ground (Low boom)	Very Fine to Fine	2.7
Ground (High boom)	Fine to Medium/Coarse	1.7
Ground (Low boom)	Fine to Medium/Coarse	1.1
Airblast (Sparse: young , dormant)	**Aerosol to Very Fine[c]**	**4.8[b]**
Airblast (Dense)	Aerosol to Very Fine	1.7[b]
Airblast (Vineyard)	Aerosol to Very Fine	0.3
Airblast (Orchard)	Aerosol to Very Fine	2.5

a This is a 50th percentile drift estimate and is not a conservative (high-end) estimate of possible exposure.
b Estimated using calculations shown in Appendix C.

[18] An example of these calculations is shown in Appendix C for 15 mph wind speeds, a limitation commonly observed on labels.
[19] The spray drift fraction is a fraction of the application rate, while the application efficiency is the fraction of the total applied that reaches the field. These fractions are not expected to sum to a value of one.
[20] U.S. EPA 2009. *Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides*. Version 2.1 October 22, 2009. Environmental Fate and Effects Division. Office of Pesticide Programs. Available at: http://www.epa.gov/oppefed1/models/water/input_parameter_guidance.htm

c This is a default input for estimating exposure in the Environmental Fate and Effects Division. The default is used in exposure modeling unless there is a reason to deviate from the default assumption.
d These defaults are based on the current model of AgDRIFT 2.1.1. These defaults should be updated as the model is updated.

2.3.b Estimating the Aquatic Spray Drift Distance

The following steps explain how to determine whether spray drift is an important component of the estimated aquatic exposure and how a spray drift distance is estimated for aquatic organisms.

1. Determine PRZM/EXAMS EECs with drift fractions, as described in Section 2.3.a.

2. Determine whether to estimate a spray drift distance. Figure 3 is a flow chart that gives an overview of when to determine the aquatic spray drift distance. The following points should be considered:

    a. If the PRZM/EXAMS EEC resulting from both runoff and drift does not result in aquatic LOC exceedances, then no additional spray drift analysis is needed.

    b. If there are LOC exceedances, determine PRZM/EXAMS EECs without drift (*e.g.*, the spray drift efficiency is set to 0). If the runoff only EEC from PRZM/EXAMS results in LOC exceedances, reducing spray drift will not mitigate the risk as estimated by PRZM/EXAMS. When discussing the impact of a spray drift buffer to the risk manager, indicate that while a spray drift buffer will not mitigate risk it will reduce risk. Estimate a spray drift distance looking at exposure to spray drift alone using AgDRIFT and only considering acute risk as specified in Section 4a on Page 16. This analysis provides information on whether acute exposure to spray drift alone could result in risk.

    c. If there are LOC exceedances when both runoff and spray drift are considered and no LOC exceedances for runoff only EECs, estimate a spray drift distance, as described in Section 4b on Page 17, using AgDRIFT and PRZM/EXAMS. Also estimate a spray drift distance looking at exposure to spray drift alone, using AgDRIFT and only considering acute risk as described in Section 4a on Page 16. This analysis provides information on whether acute exposure to spray drift alone could result in risk.

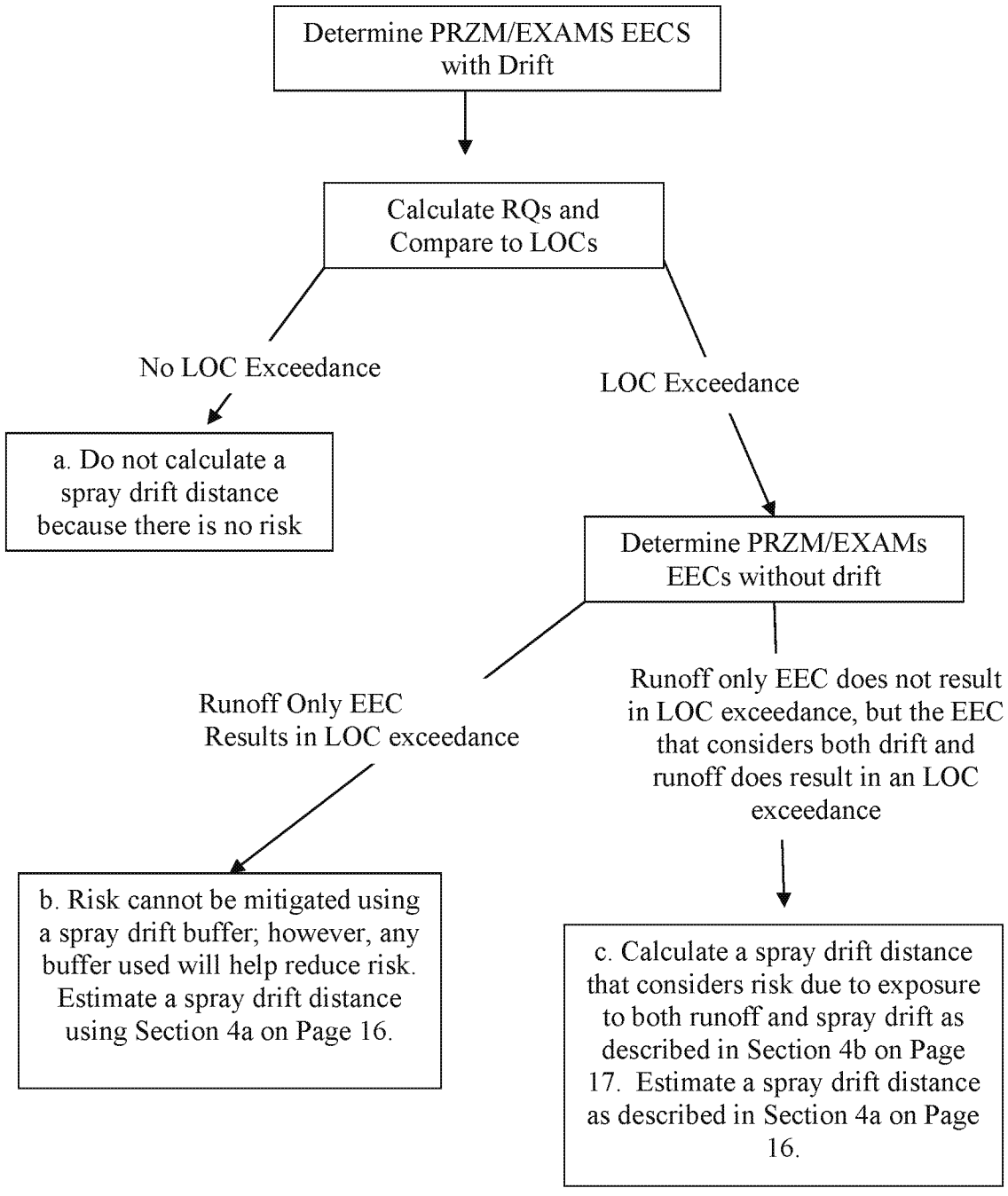

Figure 3. Flow Chart on When to Determine the Aquatic Spray Drift Distance

3. When appropriate, calculate the ratio of runoff-only EEC to the runoff plus drift EEC. A qualitative evaluation of the relative importance of drift to total loading can be made, but no quantitative criteria exist to determine how important drift is for a given chemical and use setting.

   Fraction of EEC due to Runoff = Runoff-only EEC / Runoff plus Drift EEC

This information may be used in the characterization of exposure and in explaining the results.

4. An aquatic spray drift distance may be calculated by only considering spray drift and acute exposure using AgDRIFT, described under Section a below and by considering acute and chronic exposure to both runoff and spray drift using PRZM/EXAMS and AgDRIFT (described under Section b below).

   a. To calculate the aquatic spray drift distance that considers only exposure to spray drift from a single application and acute risk to aquatic organisms, run AgDRIFT as described in Section 2.1. Under the "Toolbox" menu, choose "Aquatic Assessment." Select "EPA-Defined Pond" and input the target "Initial Average Concentration." The initial average concentration is defined by AgDRIFT as "the average concentration within a defined water body, in nanograms per liter or parts per trillion." Therefore, the input for initial average concentration is the concentration in water that will not result in an LOC exceedance. Figure 4 shows the inputs and outputs in AgDRIFT.

      Aquatic Animals:
      Target initiation average concentration = $LC_{50} \times LOC$
      Aquatic plants:
      Target initial average concentration = EC_{50} (for non-listed plants)

      The following is an example of spray drift distance calculations considering exposure spray drift only (*e.g.*, excluding runoff) from a single application. The example would apply to a label that specified use of a very fine to fine DSD.

      Tier I, Aerial Application, Very Fine to Fine DSD
      Application Rate = 0.25 lbs a.i./A
      Non-listed Species LOC = 0.5
      LC_{50} = 4 µg/L

      Estimated spray drift distance for an aquatic animal based on spray drift only

      Initial Average Concentration = $LC_{50} \times LOC$
      = 4 µg/L × 0.5 = 2 µg/L or 2000 ng/L

      The estimated spray drift distance is 105 feet.

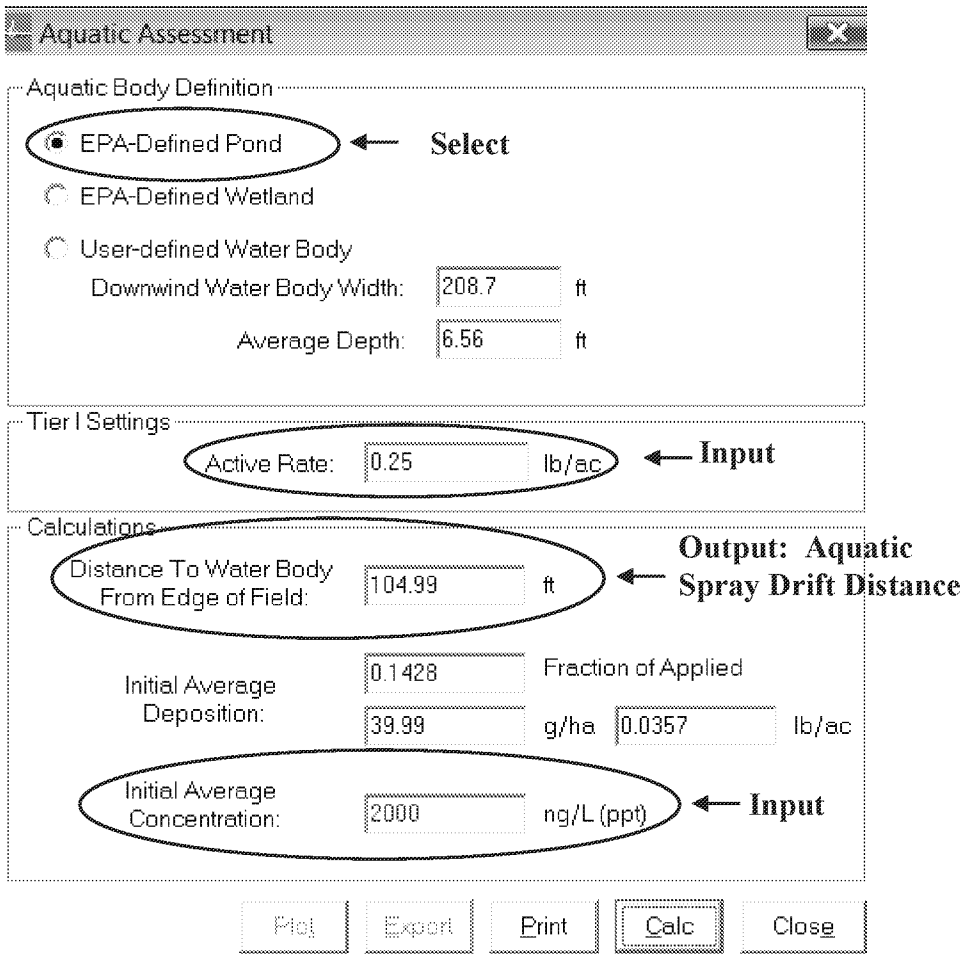

Figure 4. Example calculation of the aquatic spray drift distance using the "Active Rate" and "Initial Average Concentration" as inputs. The output is the "Distance to Point or Area Average from Edge of Field." In this calculation, the spray drift distance is 105 feet.

b. To estimate the spray drift distance considering exposure to both runoff and spray drift, use PRZM/EXAMS to find a spray drift fraction that mitigates risk and then use AgDRIFT to find the corresponding spray drift distance. Using trial and error, change the spray drift fraction input in PRZM/EXAMS and find a value that will mitigate risk to both acute and chronic exposures. Once you find the spray drift fraction that will mitigate risk, use AgDRIFT to find the corresponding buffer distance to the identified spray drift fraction. To do this, open AgDRIFT and under the "Toolbox" menu, choose "Aquatic Assessment." Select "EPA-Defined Pond" and input the spray drift fraction that will mitigate risk into the "Fraction of Applied." The output will be "Distance to the Water Body from Edge of Field, which will mitigate risk to aquatic organisms.

5. Round all spray drift distances to a whole number. Report all inputs and outputs used for modeling in the risk assessment.

2.4. *Reporting on Modeling Procedures, Results, and Uncertainties*

This section provides some example language that may be used to discuss both aquatic and terrestrial spray drift distances. The purpose of the language is to provide an example discussion of the uncertainty involving one and multiple applications and involving a situation where a greater than value occurs for a spray drift distance. The language is very basic and should be edited as needed to summarize the spray drift distance results in an assessment, especially with regard to direct and indirect effects. Tables 3 and 4 show some example results for terrestrial spray drift distances. In the example, the maximum spray drift distance would be greater than 997 feet.

Table X shows the spray drift distances estimated using LOCs divided by risk quotients (calculated based on multiple applications) as the "Fraction of Applied" in AgDRIFT to estimate the spray drift distance for terrestrial animals. Based on AgDRIFT[21], potential direct effects from exposure to spray drift may occur at greater than 997 feet from the use site for multiple applications.

The distance estimated for plants is based on one application and does not reflect possible cumulative exposure from multiple applications. It is recognized that a species could receive exposure from multiple applications, in which case, this distance may underestimate risk. The distance estimated for aquatic and terrestrial animals for multiple applications may occur when wind is blowing consistently in one direction for all applications or when wind is blowing in different directions during different applications as long as the organism is downwind in each case and regardless of whether it is mobile or stationary. This may result in an overestimation of exposure for aquatic and terrestrial organisms whose spray drift distances are based on exposure to the maximum number of applications and who are not downwind of every application. Exposure to multiple applications is more likely to occur when agricultural fields/use areas are on multiple sides of an aquatic or terrestrial area of interest and when local wind direction is not variable.

Table 3. Example of Spray Drift Distances Calculated for Terrestrial Animals, Assuming Aerial Application*

Taxa	Type of Endpoint	Highest Risk Quotient	LOC**	Fraction of Applied = LOC/RQ	Spray Drift Distance (feet)
Birds	Acute	25	0.5	0.02	479
	Chronic	6.9	1	0.14	69
Mammals	Acute	16.7	0.5	0.03	312
	Chronic	136.23	1	0.01	>997

RQ=risk quotient

* A spray drift estimation of zero may result when the highest RQ exceeds the LOC because the model used to estimate spray drift exposure is a different model from the model used to estimate terrestrial EECs. In this case, the spray drift distance needed to mitigate risk is expected to be very small.

**The LOCs shown are for non-listed species.

[21] *Modeled using the following input parameters for AgDRIFT: maximum application rate, Tier I Terrestrial Assessment, aerial application, ASAE Fine to Medium DSD, and assuming a single application.*

Table 4. Example of Spray Drift Distance for Non-listed Terrestrial Plants

Taxa	EC_{25}(lbs ai/A)	Maximum Application Rate in (lbs ai/A)	Spray Drift Distance for One Application (feet)
Terrestrial Plants	0.0067	4	>997

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Appendix A. Comparison of Results from Tier I, Tier II, and Tier III AgDRIFT Analysis Using the ASAE Very Fine to Fine DSD and Fine to Medium DSD

Table A1. Comparison of the Distances from Edge of Field to Point Downwind from Tier I, Tier II, and Tier III AgDRIFT Terrestrial Assessments Using the Default Input Parameters Specified in Section 2.1 and the Specified DSD

Fraction of Applied Deposited at Point Downwind	Spray Drift Distance (Feet)									
	ASAE Very Fine to Fine DSD					ASAE Fine to Medium DSD				
	Tier I	Tier II	Tier II÷ Tier I	Tier III	Tier III÷ Tier I	Tier I	Tier II	Tier II÷ Tier I	Tier III	Tier III÷ Tier I
0.01	Out of Range	Out of Range	na	na	na	Out of Range	Out of Range	na	1387.78	na
0.02	Out of Range	Out of Range	na	na	na	479	479	1.00	479	1.00
0.03	Out of Range	Out of Range	na	na	na	311.68	311.68	1.00	314.96	1.01
0.04	Out of range	Out of Range	na	1076.1	na	236.22	232.94	0.99	236.22	1.00
0.05	741.46	708.65	0.96	741.46	1.00	183.72	183.72	1.00	187.01	1.02
0.06	577.42	557.74	0.97	577.42	1.00	160.76	160.76	1.00	160.76	1.00
0.08	400.26	390.42	0.98	400.26	1.00	121.39	121.39	1.00	121.39	1.00
0.1	305.11	295.27	0.97	305.11	1.00	98.42	98.42	1.00	98.42	1.00
0.2	124.67	121.39	0.97	124.67	1.00	32.81	32.81	1.00	32.81	1.00
0.3	52	52.49	1.01	52.49	1.01	16.4	16.4	1.00	16.4	1.00
0.4	16	13.12	0.82	16.4	1.03	6.56	6.56	1.00	6.56	1.00
0.5	3	0	0.00	3.28	1.09	0	3.28	na	0	na
0.6	0	0	na		na	0	0	na	0	na

na=not applicable

Table A2. Comparison of Distances from Edge of Field to Water Body from Tier I, Tier II, and Tier III AgDRIFT Aquatic Assessments Using the Default Input Parameters Specified in Section 2.1 and the Specified DSD

Initial Average Concentration (ng/L) in Water Body with Active Rate of 0.2505	Spray Drift Distance to Water Body (Feet)									
	Very Fine to Fine DSD					Fine to Medium DSD				
	Tier I	Tier II	Tier II÷ Tier I	Tier III	Tier III÷ Tier I	Tier I	Tier II	Tier II÷ Tier I	Tier III	Tier III÷ Tier I
3300	7	3	0.5	7	1	0	0	na	0	na
3000	23	20	0.86	23	1	0	0	na	0	na
2000	105	102	0.97	108	1.03	0	0	na	0	na
1000	367	354	0.96	367	1	55.77	55.77	1.00	55.77	1.00
950	397	381	0.96	400	1.01	62.34	62.34	1.00	62.34	1.00
800	522	499	0.96	522	1	85.3	85.3	1.00	85.3	1.00
700	646	617	0.95	646	1	104.99	104.99	1.00	104.99	1.00
600	850	804	0.95	853	1	134.51	131.23	0.98	134.51	1.00
556	994	938	0.94	1001	1.01	150.92	147.64	0.98	147.64	0.98
550	Out of range	955	na	1020	na	150.92	150.92	1.00	150.92	1.00
540	Out of range	994	na	1063	na	154.2	154.2	1.00	154.2	1.00
530	Out of range	Out of range	na	1106	na	160.76	157.48	0.98	160.76	1.00
257	Out of range	Out of range	Out of range	2605	na	433.07	423.22	0.98	433.07	1.00
200	na	na	na	na	na	623.35	610.23	0.98	626.63	1.01
157	na	na	na	na	na	990.8	967.84	0.98	997.36	1.01
156	na	na	na	na	na	Out of Range	980.96	na	1010.49	na
155	na	na	na	na	na	Out of Range	994.08	na	1026.89	na
154	na	na	na	na	na	Out of Range	Out of Range		1043.29	na

Initial Average Concentration (ng/L) in Water Body with Active Rate of 0.2505	Spray Drift Distance to Water Body (Feet)									
	Very Fine to Fine DSD					Fine to Medium DSD				
	Tier I	Tier II	Tier II÷ Tier I	Tier III	Tier III÷ Tier I	Tier I	Tier II	Tier II÷ Tier I	Tier III	Tier III÷ Tier I
100	na	na	na	na	na	Out of Range	Out of Range		1952.08	na
64	na	na	na	na	na	Out of Range	Out of Range		2595.11	na
63	na	na	na	na	na	Out of Range	Out of Range		Out of Range	na

na=not applicable

Appendix B. How to Determine the Aquatic and Terrestrial Spray Drift Fraction for an Application Rate in AgDRIFT for Ecological Assessments

1. Select the default input parameters for Tier I analysis as described in Section 2.1.

2. Select "Tool box" and then "Aquatic Assessment" or "Terrestrial Assessment".

3. Select the appropriate water body from the following choices:

   For an aquatic assessment, select:
   a. "EPA-Defined Pond": Pond with a depth of 2 meters (6.56 ft) and a downwind width of 63.61 m (208.69 ft) and flight line width of 157.21 m (515.78 ft for a 1 ha pond).

   For a terrestrial assessment, select point deposition.

4. Enter the maximum application rate for the use being evaluated in the "Active Rate" window. This input does not change the fraction of applied pesticide distributed to the water body.

5. Enter a "Distance to Point or Water Body from Edge of Field" (Figure B1). If a distance is not specified on the label, the "Distance to the Point of Water Body from the Edge of Field" is zero for aquatic ecological risk assessments and one foot for terrestrial assessments. For Drinking Water Assessments, see Appendix C. Click the "Calc" button. The model then reports the "Fraction of Applied," which is the estimated spray drift fraction or fraction of pesticide application rate that will enter the water body or will be deposited at a point off the field for a terrestrial assessment.[1] Tables B1-B6 provide some example outputs for standard spray drift fractions associated with different distances.

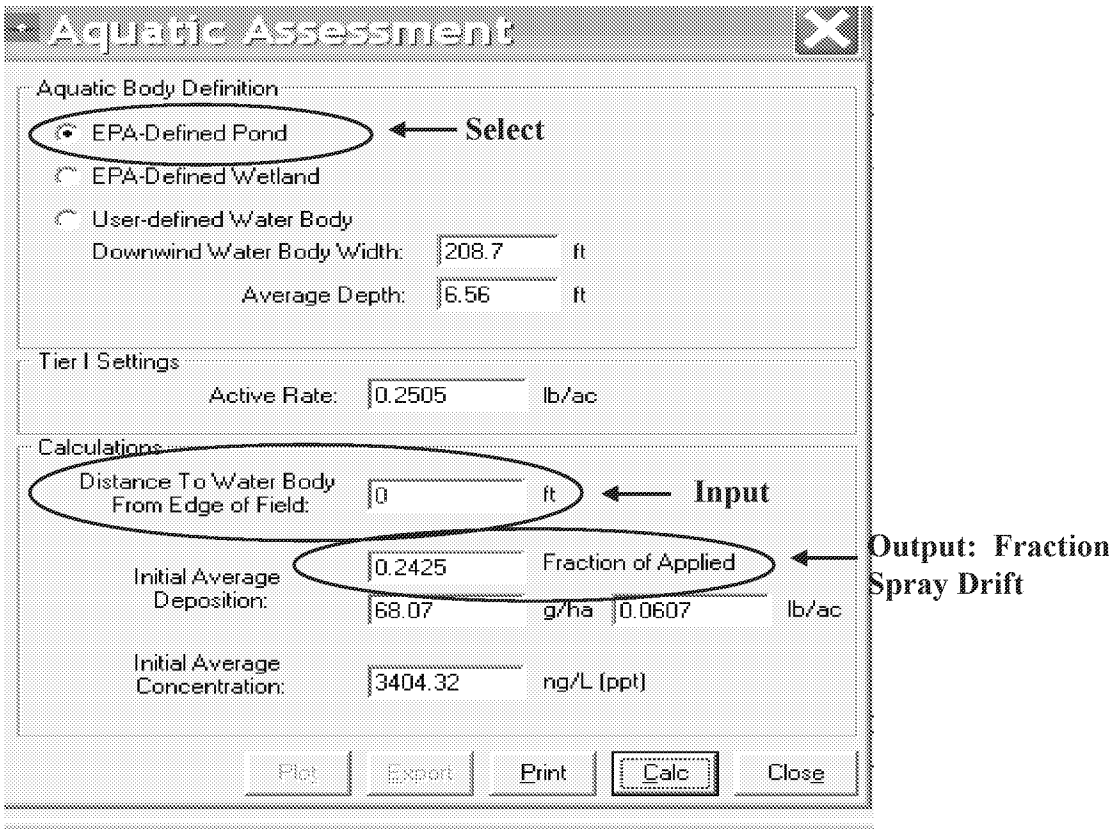

Figure B1. Example of the AgDRIFT input and output screen used to determine the spray drift fraction. The input is the "Distance to Water Body from Edge of Field" shown in red and the output is the "Fraction of Applied" or spray drift fraction.

Table B1. Fraction of Applied Pesticide at Different Distances from the Edge of the Field to the Water Body that will be Distributed into the EPA Pond with Ground Application (Calculated using Tier I Model in AgDRIFT version 2.1.1)

Distance from Edge of Field to Water Body (feet)	Fraction of Applied or Spray Drift Fraction			
	High Boom		Low Boom	
	ASAE Very Fine to Fine	ASAE Fine to Medium/Coarse	ASAE Very Fine to Fine	ASAE Fine to Medium/Coarse
0	0.0616	0.0165	0.0268	0.0109
1	0.0572	0.0137	0.0231	0.0086
5	0.0455	0.0104	0.0167	0.0065
10	0.0376	0.009	0.0136	0.0056
25	0.0267	0.0071	0.01	0.0045
50	0.0194	0.0056	0.0076	0.0036
100	0.013	0.0042	0.0054	0.0028
150	0.0098	0.0034	0.0043	0.0023
200	0.0078	0.0028	0.0036	0.0019
250	0.0064	0.0024	0.0031	0.0017
300	0.0053	0.0021	0.0027	0.0015
350	0.0046	0.0019	0.0024	0.0013
400	0.0039	0.0017	0.0021	0.0012
450	0.0035	0.0015	0.0019	0.0011

Distance from Edge of Field to Water Body (feet)	Fraction of Applied or Spray Drift Fraction			
	High Boom		Low Boom	
	ASAE Very Fine to Fine	ASAE Fine to Medium/Coarse	ASAE Very Fine to Fine	ASAE Fine to Medium/Coarse
500	0.003	0.0014	0.0017	0.001
550	0.0027	0.0013	0.0016	0.0009
600	0.0024	0.0012	0.0015	0.0009
650	0.0022	0.0011	0.0013	0.0008
700	0.002	0.001	0.0012	0.0008
750	0.0018	0.0009	0.0012	0.0007
800	0.0017	0.0009	0.0011	0.0007
850	0.0015	0.0008	0.001	0.0006
900	0.0014	0.0008	0.001	0.0006
950	0.0013	0.0007	0.0009	0.0006
997	0.0012	0.0007	0.0009	0.0006
998	Out of range	Out of range	Out of range	Out of range

Table B3. Fraction of Applied Pesticide at Different Distances from the Edge of the Field to the Water Body that will be Distributed into the EPA Pond with Aerial Application (Calculated Using Tier I Model in AgDRIFT Version 2.1.1)

Distance from Edge of Field to the Water Body (feet)	Fraction of Applied or Spray Drift Fraction		
	ASAE Very Fine to Fine	ASAE Fine to Medium	ASAE Medium to Coarse
0	0.2421	0.1254	0.0885
1	0.2405	0.1276	0.0866
5	0.2340	0.116	0.0789
10	0.2266	0.1082	0.0713
25	0.2076	0.0916	0.0564
50	0.1821	0.0733	0.0428
100	0.1446	0.0503	0.0271
150	0.1196	0.0385	0.0197
200	0.1023	0.0314	0.0154
250	0.0889	0.0266	0.0126
300	0.0804	0.0231	0.0108
350	0.0730	0.0205	0.0095
400	0.0670	0.0186	0.0086
450	0.0622	0.0172	0.0081
500	0.0582	0.016	0.0074
550	0.0549	0.015	0.007
600	0.052	0.0144	0.0066
650	0.0495	0.0138	0.0063
700	0.0474	0.0132	0.0061
750	0.0455	0.0128	0.0058
800	0.0439	0.0124	0.0056
850	0.0425	0.012	0.0055
900	0.0412	0.0117	0.0053
950	0.0401	0.0114	0.0052
997	0.0392	0.0111	0.0051

Distance from Edge of Field to the Water Body (feet)	Fraction of Applied or Spray Drift Fraction		
	ASAE Very Fine to Fine	ASAE Fine to Medium	ASAE Medium to Coarse
998	Out of range	Out of range	Out of range

Table B4. Fraction of Applied Pesticide at Different Distances from the Edge of the Field to a Terrestrial Point with Aerial Application (Calculated Using Tier I Model in AgDRIFT Version 2.01)

Distance from Edge of Field to Terrestrial Point	Fraction of Applied or Spray Drift Fraction		
	ASAE Very Fine to Fine	ASAE Fine to Medium	ASAE Medium to Coarse
0	0.5001	0.5	0.5
1	0.4916	0.4808	0.4768
5	0.4572	0.4	0.3842
10	0.4234	0.3347	0.3
25	0.361	0.2207	0.1698
50	0.3011	0.1709	0.1108
100	0.2236	0.0978	0.0572
150	0.1756	0.0627	0.0345
200	0.1401	0.0456	0.0245
250	0.1159	0.0367	0.0184
300	0.1001	0.0306	0.0146
350	0.0886	0.026	0.0122
400	0.0796	0.0227	0.0106
450	0.0725	0.0203	0.0094
500	0.0666	0.0185	0.0085
550	0.0621	0.0171	0.0079
600	0.0583	0.016	0.0074
650	0.0548	0.0151	0.007
700	0.0518	0.0146	0.0066
750	0.0494	0.0137	0.0063
800	0.0474	0.0132	0.006
850	0.0455	0.0128	0.0058
900	0.0439	0.0124	0.0057
950	0.0425	0.012	0.0055
997	0.0413	0.0117	0.0053
998	Out of range	Out of range	Out of range

Table B5. Fraction of Applied Pesticide at Different Distances from the Edge of the Field to a Terrestrial Point with Ground Application with a High Boom (Calculated Using Tier I Model in AgDRIFT Version 2.1.1)

Distance from Edge of Field to Terrestrial Point (feet)	Fraction of Applied or Spray Drift Fraction	
	ASAE Very Fine to Fine	ASAE Fine to Medium/Coarse
0	1.06	1.01
1	0.8564	0.3731

Distance from Edge of Field to Terrestrial Point (feet)	Fraction of Applied or Spray Drift Fraction	
	ASAE Very Fine to Fine	ASAE Fine to Medium/Coarse
5	0.4475	0.0889
10	0.2595	0.0459
25	0.104	0.0208
50	0.05	0.0119
100	0.0248	0.007
150	0.0164	0.0051
200	0.012	0.004
250	0.0093	0.0033
300	0.0075	0.0028
350	0.0062	0.0024
400	0.0053	0.0021
450	0.0045	0.0019
500	0.0039	0.0017
550	0.0034	0.0015
600	0.003	0.0014
650	0.0027	0.0013
700	0.0024	0.0012
750	0.0022	0.0011
800	0.002	0.001
850	0.0018	0.0009
900	0.0017	0.0009
950	0.0015	0.0008
997	0.0014	0.0008
998	Out of range	Out of range

Table B6. Fraction of Applied Pesticide at Different Distances from the Edge of the Field to a EPA Pond with Airblast Application (Calculated Using Tier I Model in AgDRIFT Version 2.01)

Distance from edge of field to water body (feet)	Fraction of Applied or Spray Drift Fraction				
	Normal (Stone and Pome Fruit, Vineyard)	Dense (Citrus, Tall Trees)	Sparse (Young, Dormant)	Vineyard	Orchard
0	0.0011	0.0145	0.0416	0.0024	0.0218
1	0.0011	0.014	0.0395	0.0023	0.0208
5	0.001	0.0122	0.0323	0.0018	0.0175
10	0.0009	0.0106	0.0258	0.0014	0.0145
25	0.0007	0.0074	0.015	0.0009	0.0093
50	0.0005	0.005	0.0077	0.0006	0.0056
100	0.0003	0.003	0.0031	0.0003	0.0031
150	0.0002	0.0022	0.0017	0.0002	0.0021
200	0.0002	0.0017	0.001	0.0002	0.0016
250	0.0002	0.0014	0.0007	0.0001	0.0013
300	0.0001	0.0012	0.0005	0.0001	0.0011
350	0.0001	0.0011	0.0004	0.0001	0.0009

400	0.0000978	0.001	0.0003	0.0000881	0.0008
450	0.0000863	0.0009	0.0002	0.0000765	0.0007
500	0.0000769	0.0008	0.0002	0.0000672	0.0007
550	0.0000629	0.0007	0.0002	0.0000596	0.0006
600	0.0000626	0.0007	0.0001	0.0000533	0.0005
650	0.0000571	0.0006	0.0001	0.000048	0.0005
700	0.0000523	0.0006	0.0000898	0.0000435	0.0005
750	0.0000482	0.0005	0.0000771	0.0000397	0.0004
800	0.0000446	0.0005	0.0000668	0.0000363	0.0004
850	0.0000414	0.0005	0.0000583	0.0000334	0.0004
900	0.0000386	0.0005	0.0000513	0.0000309	0.0004
950	0.0000361	0.0004	0.0000453	0.0000286	0.0003
997	0.0000339	0.0004	0.0000405	0.0000267	0.0003
998	Out of Range	Out of Range	Out of Range	Out of Range	Out of Range

Table B7. Fraction of Applied Pesticide at Different Distances from the Edge of the Field to a Terrestrial Point with Airblast Application (Calculated Using Tier I Model in AgDRIFT Version 2.1.1)

Distance from edge of field to water body (feet)	Fraction of Applied or Spray Drift Fraction				
	Normal (Stone and Pome Fruit, Vineyard)	Dense (Citrus, Tall Trees)	Sparse (Young, Dormant)	Vineyard	Orchard
0	0.0089	0.1155	0.4763	0.0376	0.2223
1	0.0081	0.1078	0.4385	0.0324	0.2046
5	0.0058	0.0834	0.3218	0.0195	0.1506
10	0.0042	0.0631	0.2285	0.012	0.108
25	0.0023	0.033	0.1007	0.0047	0.0503
50	0.0012	0.0157	0.0373	0.0019	0.021
100	0.0006	0.0065	0.0103	0.0008	0.0074
150	0.0004	0.0038	0.0044	0.0004	0.004
200	0.0003	0.0026	0.0023	0.0003	0.0026
250	0.0002	0.002	0.0014	0.0002	0.0019
300	0.0002	0.0016	0.0009	0.0002	0.0015
350	0.0002	0.0014	0.0006	0.0001	0.0012
400	0.0001	0.0012	0.0005	0.0001	0.0011
450	0.0001	0.0011	0.0004	0.0001	0.0009
500	0.0000965	0.0009	0.0003	0.000087	0.0008
600	0.0000765	0.0008	0.0002	0.0000667	0.0006
700	0.0000625	0.0007	0.0001	0.0000531	0.0005
800	0.0000523	0.0006	0.0000889	0.0000434	0.0005
900	0.0000446	0.0005	0.0000665	0.0000363	0.0004
997	0.0000387	0.0005	0.0000514	0.000031	0.0004
998	Out of Range	Out of Range	Out of Range	Out of Range	Out of Range

Appendix C. Calculation of the Spray Drift Fraction for Drinking Water Assessments Using the Index Reservoir.

The index reservoir scenario is used to model simulations to estimate drinking water exposure and is intended as a replacement of the "standard pond," which is used to estimate wildlife exposure in aquatic ecosystems. The scenario is developed based on the Shipman City Lake in Shipman, Illinois. It includes ephemeral and perennial streams that run into a reservoir. For detailed information on use of the index reservoir in drinking water assessments, refer to *Guidance on Development and Use of the Index Reservoir in Drinking Water* (USEPA, 2010). The spray drift fraction for the index reservoir is calculated using AgDRIFT by adding the spray drift fraction of the reservoir (82-m width, 640-m length, 2.7-m average depth, no buffer) to the spray drift fraction of all streams (4-m width, 1500-m length, variable depth, 4-m buffer) normalized to the index reservoir as follows:

Normalized Spray Drift Fraction for Streams (unitless) =

$$\text{Spray Drift Fraction of all Streams} \times \frac{\text{Surface Area of All Streams}}{\text{Surface Area of Reservoir}}$$

Adjusted Spray Drift Fraction for Index Reservoir (unitless) =

$$\text{Normalized Spray Drift Fraction for Streams} + \text{Spray Drift Fraction of Reservoir}$$

Table C1 provides the estimated spray drift fraction of the application rate for the index reservoir and the outputs from AgDRIFT used to make this calculation. At 10 mph wind speeds, the spray drift fraction of the application rate for the index reservoir is 14% for aerial applications, 7% for ground applications, and 14% for airblast applications, using the default spray drift inputs as specified in Section 2.1 and Tier I AgDRIFT version 2.1.1. The corresponding spray drift fraction at 15 mph wind speeds is 16% for aerial applications.

Table C1. Estimate the Spray Drift Fraction for Drinking Water Assessments Using Tier I (10 mph wind speed) or Tier II (15 mph wind speed) Analysis in AgDRIFT Version 2.1.1

Scenario	Spray Drift Fraction Estimated from AgDRIFT			Normalized Spray Drift Fraction		
	Aerial, Fine to Medium DSD[1]	Ground[3,5]	Airblast[4]	Aerial, Fine to Medium DSD[1]	Ground[3,5]	Airblast[4]
10 mph (4.47 m/s) Wind Speed						
Reservoir	0.106	0.05	0.0326	0.106	0.05	0.0326
All Streams with 4-m buffer	0.2531	0.1406	0.1353[7]	0.0289	0.0161	0.0155
Index Reservoir				0.1349	0.0661	0.048
15 mph (6.71 m/s) Wind Speed						
Reservoir	0.1537	NA[5]	NA[5]	0.1537	NA[5]	NA
All Streams with 4-m buffer	0.408	NA[5]	NA[5]	0.0466	NA[5]	NA
Index Reservoir				0.2003	NA[5]	NA

[1] Assumed Fine to Medium DSD.
[2] Assumed Very Fine to Fine DSD.
[3] Assumed Very Fine to Fine DSD, high boom, and 90th data percentile.

[4] Assumed sparse, young dormant orchard.
[5] Ground and airblast applications are not adjusted for windspeed.

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Appendix D. Example and Validation of Terrestrial Spray Drift Distance Approach

Calculation of Risk Quotients (output from T-REX v 1.4.1)

Upper Bound Kenaga Residues For RQ Calculation

Chemical Name:	Chemical X
Use	Corn
Formulation	Product X
Application Rate	1 lbs a.i./acre
Half-life	35 days
Application Interval	7 days
Maximum # Apps./Year	5
Length of Simulation	1 year

Endpoints			
Avian	Mallard duck	LD50 (mg/kg-bw)	500.00
	Bobwhite quail	LC50 (mg/kg-diet)	200.00
	Mallard duck	NOAEL(mg/kg-bw)	10.00
	Bobwhite quail	NOAEC (mg/kg-diet)	10.00
Mammals		LD50 (mg/kg-bw)	500.00
		LC50 (mg/kg-diet)	200.00
		NOAEL (mg/kg-bw)	10.00
		NOAEC (mg/kg-diet)	10.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	927.00
Tall Grass	424.88
Broadleaf plants/sm Insects	521.44
Fruits/pods/seeds/lg insects	57.94

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Avian Results

Avian Class	Body Weight (g)	Ingestion (Fdry) (g bw/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Small	20	5	23	114	2.28E-02
Mid	100	13	65	65	6.49E-02
Large	1000	58	291	29	2.91E-01
Granivores	20	5	5	25	5.06E-03
	100	13	14	14	1.44E-02
	1000	58	65	6	6.46E-02

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	259.61
100	330.50
1000	466.84

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams)					
	small 20	mid 100	large 1000	Granivores(grams) 20	100	1000
Short Grass	1055.76	602.04	269.54			
Tall Grass	483.89	275.94	123.54			
Broadleaf plants/sm Insects	593.87	338.65	151.62			
Fruits/pods/seeds/lg insects	65.99	37.63	16.85	14.66	8.36	3.74

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams)		
	20	100	1000
Short Grass	4.07	1.82	0.58
Tall Grass	1.86	0.83	0.26
Broadleaf plants/sm insects	2.29	1.02	0.32
Fruits/pods/seeds/lg insects	0.25	0.11	0.04
Seeds (granivore)	0.06	0.03	0.01

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	RQs	
	Acute	Chronic
Short Grass	4.64	92.70
Tall Grass	2.12	42.49
Broadleaf plants/sm Insects	2.61	52.14
Fruits/pods/seeds/lg insects	0.29	5.79

Mammalian Results

Mammalian Class	Body Weight	Ingestion (Fdry) (g bwt/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Herbivores/ insectivores	15	3	14	95	1.43E-02
	35	5	23	66	2.31E-02
	1000	31	153	15	1.53E-01
Grainvores	15	3	3	21	3.18E-03
	35	5	5	15	5.13E-03
	1000	31	34	3	3.40E-02

Mammalian Class	Body Weight	Adjusted LD50	Adjusted NOAEL
Herbivores/ insectivores	15	1098.92	21.98
	35	889.14	17.78
	1000	384.58	7.69
Grainvores	15	1098.92	21.98
	35	889.14	17.78
	1000	384.58	7.69

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight					
	Herbivores/ insectivores (grams)			Granivores(grams)		
	15	35	1000	15	35	1000
Short Grass	883.83	610.84	141.63			
Tall Grass	405.09	279.97	64.91			
Broadleaf plants/sm Insects	497.15	343.60	79.66			
Fruits/pods/seeds/lg insects	55.24	38.18	8.85	12.28	8.48	1.97

Dose-based RQs (Dose-based EEC/LD50 or NOAEL)	Small mammal 15 grams		Medium mammal 35 grams		Large mammal 1000 grams	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	0.80	40.21	0.69	34.35	0.37	18.41
Tall Grass	0.37	18.43	0.31	15.74	0.17	8.44
Broadleaf plants/sm insects	0.45	22.62	0.39	19.32	0.21	10.36
Fruits/pods/lg insects	0.05	2.51	0.04	2.15	0.02	1.15
Seeds (granivore)	0.01	0.56	0.01	0.48	0.01	0.26

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs	
	Acute	Chronic
Short Grass	4.64	92.70
Tall Grass	2.12	42.49
Broadleaf plants/sm insects	2.61	52.14
Fruits/pods/seeds/lg insects	0.29	5.79

Table D1. Summary of the Calculation of Fraction of Applied.

Taxa	Type of Endpoint	Highest Risk Quotient	LOC	Fraction of Applied = LOC/RQ
Birds	Acute Oral	4.07	0.5	0.12
	Acute Dietary	4.64	0.5	0.11
	Chronic	92.70	1	0.011
Mammals	Acute Oral	0.80	0.5	0.625
	Acute Dietary	4.64	0.5	0.11
	Chronic	92.70	1	0.011

The spray drift distance that corresponds to 0.01 is out of range or greater than 997 feet. To verify that the fraction of applied would reduce the risk quotient to a value below LOCs, the Fraction of Applied is multiplied by the application rate and that is used as an input in T-REX. Note that all RQs are below LOCs in the T-REX output shown below. Also, note that this method will be applicable to both single and multiple applications.

Upper Bound Kenaga Residues For RQ Calculation

Chemical Name:	Chemical X
Use	Corn
Formulation	Product X
Application Rate	0.01 lbs a.i./acre
Half-life	35* days
Application Interval	7 days
Maximum # Apps./Year	5
Length of Simulation	1 year

Endpoints			
Avian	Mallard duck	LD50 (mg/kg-bw)	500.00
	Bobwhite quail	LC50 (mg/kg-diet)	200.00
	Mallard duck	NOAEL(mg/kg-bw)	10.00
	Bobwhite quail	NOAEC (mg/kg-diet)	10.00
Mammals		LD50 (mg/kg-bw)	500.00
		LC50 (mg/kg-diet)	200.00
		NOAEL (mg/kg-bw)	10.00
		NOAEC (mg/kg-diet)	10.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	9.27
Tall Grass	4.25
Broadleaf plants/sm Insects	5.21
Fruits/pods/seeds/lg insects	0.58

Acute and Chronic RQs are based on the Upper Bound Kenaga Residues.

The maximum single day residue estimation is used for both the acute and reproduction RQs.

RQs reported as "0.00" in the RQ tables below should be noted as <0.01 in your assessment. This is due to rounding and significant figure issues in Excel.

Questions? Comments? Click here

Avian Results

Avian Class	Body Weight (g)	Ingestion (Fdry) (g bw/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Small	20	5	23	114	2.28E-02
Mid	100	13	65	65	6.49E-02
Large	1000	58	291	29	2.91E-01
Granivores	20	5	5	25	5.06E-03
	100	13	14	14	1.44E-02
	1000	58	65	6	6.46E-02

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	259.61
100	330.50
1000	466.84

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams)					
	small 20	mid 100	large 1000	Granivores(grams) 20	100	1000
Short Grass	10.56	6.02	2.70			
Tall Grass	4.84	2.76	1.24			
Broadleaf plants/sm Insects	5.94	3.39	1.52			
Fruits/pods/seeds/lg insects	0.66	0.38	0.17	0.15	0.08	0.04

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams)		
	20	100	1000
Short Grass	0.04	0.02	0.01
Tall Grass	0.02	0.01	0.00
Broadleaf plants/sm insects	0.02	0.01	0.00
Fruits/pods/seeds/lg insects	0.00	0.00	0.00
Seeds (granivore)	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	RQs	
	Acute	Chronic
Short Grass	0.05	0.93
Tall Grass	0.02	0.42
Broadleaf plants/sm Insects	0.03	0.52
Fruits/pods/seeds/lg insects	0.00	0.06

Mammalian Results

Mammalian Class	Body Weight	Ingestion (Fdry) (g bwt/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Herbivores/ insectivores	15	3	14	95	1.43E-02
	35	5	23	66	2.31E-02
	1000	31	153	15	1.53E-01
Grainvores	15	3	3	21	3.18E-03
	35	5	5	15	5.13E-03
	1000	31	34	3	3.40E-02

Mammalian Class	Body Weight	Adjusted LD50	Adjusted NOAEL
Herbivores/ insectivores	15	1098.92	21.98
	35	889.14	17.78
	1000	384.58	7.69
Grainvores	15	1098.92	21.98
	35	889.14	17.78
	1000	384.58	7.69

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight					
	Herbivores/ insectivores (grams)			Granivores(grams)		
	15	35	1000	15	35	1000
Short Grass	8.84	6.11	1.42			
Tall Grass	4.05	2.80	0.65			
Broadleaf plants/sm Insects	4.97	3.44	0.80			
Fruits/pods/seeds/lg insects	0.55	0.38	0.09	0.12	0.08	0.02

Dose-based RQs (Dose-based EEC/LD50 or NOAEL)	Small mammal 15 grams		Medium mammal 35 grams		Large mammal 1000 grams	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	0.01	0.40	0.01	0.34	0.00	0.18
Tall Grass	0.00	0.18	0.00	0.16	0.00	0.08
Broadleaf plants/sm insects	0.00	0.23	0.00	0.19	0.00	0.10
Fruits/pods/lg insects	0.00	0.03	0.00	0.02	0.00	0.01
Seeds (granivore)	0.00	0.01	0.00	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs	
	Acute	Chronic
Short Grass	0.05	0.93
Tall Grass	0.02	0.42
Broadleaf plants/sm insects	0.03	0.52
Fruits/pods/seeds/lg insects	0.00	0.06